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PATENT SPECIFICATION

(11) 1 204 651

DRAWINGS ATTACHED

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(54) ELECTRICAL CURRENT FLOW INDICATING SYSTEM

(71) I, ROLAND ERIC GUNTHER, a Citizen of the United States of America, of 100 Joanne Street, Princetown Junction, New Jersey, U.S.A., do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention pertains to a type of current flow monitoring system with which it is possible instantaneously and continuously to detect whether electrical current is flowing in any one of a variety of equipments normally operable from conventional a.c. mains.

There are many electrically operated equipments in use today which give immediate evidence of current flow when functioning properly. The evidence may be in the form of motion, sound or other physical phenomena. However, when there is a malfunction and the usual end result is not in evidence, the immediate question arises: "is current flowing or not flowing in the unit?"

There are also cases in which evidence of current flow is not so readily discernible. Such equipment is usually provided with pilot lights, but in the conventional method of using pilot lights such lights show only that current to the equipment has been turned on. It does not tell whether the current is actually flowing.

Devices for showing that current is flowing are available, of course. The best known one is the ammeter; it has the added advantage of providing quantitative information on the current. It is not standard equipment on much of the electrically operated equipment in use today. It may be that its cost is too high in comparison with that of the mass produced equipment on which it might be applicable. It has the disadvantage of not attracting attention as a light does.

Current sensing circuits have been designed and reported in the literature (D.V. Jones, Electronics, Vol. 38, No. 12, p. 110, 14 June 1965). They may be expected to require their own d.c. power supply, and to sense currents of a particular order of magnitude only.

It is an important object of the invention to provide a simple and inexpensive electrical current flow indicator system.

The invention consists of an electrical current flow indicator system for indicating current flow in a.c. powered equipment comprising a thyristor for connection with the anode-cathode path in series between the a.c. power source for the equipment and the equipment, circuitry to trigger the thyristor when so connected from the a.c. source, and a current indicating device forming at least part of an indicating device circuit for connection in parallel with the equipment, the current indicating device circuit having a current demand substantially lower than the holding current of the thyristor so that in the event that current does not flow in the equipment the holding current of the thyristor will not be maintained and the indicating device will not operate.

The current indicating device may be a lamp and the lamp may be a neon lamp. The thyristor may be a silicon controlled rectifier (SCR) or a triac, which is a gated silicon controlled rectifier which, when gated, conducts in either direction.

In the drawing Figure 1 shows a circuit incorporating the invention with an SCR or thyristor;

Figure 2 shows the invention in a basic SCR controller circuit;

Figure 3 shows the invention incorporated in a triac type controller circuit; and

Figure 4 shows the invention in a circuit providing sensitivity adjustment.

In detail, Figure 1 shows an alternating current source 1, one pole of which connects to a switch 2, which when closed provides a continuing path to load 3. Normal current flow continues from the load to the anode of an SCR 6 then out at the cathode of the SCR and back to the a.c. source. Shunted across the load 3 is a neon lamp 4 in series with a limiting resistor 5, and connected between the anode and the gate of the SCR is a resistor 7.

It is significant that the neon light and its associated resistor is connected in the manner described and not in the conventional fashion

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to provide a sub-circuit which extends from one pole of the power source through the switch, through the lamp and resistor back to the other pole of the power source.

The key to the operation of this invention lies in the fact that thyristors require a minimum "holding current" for conduction to be maintained between anode and cathode once the device has been fired. Typical holding currents for popular SCR units are mostly between 8 and 20 mA. When the load draws at least this amount of current the SCR will conduct, and since the circuit provides current for the load it can also supply current for the neon lamp circuit.

Should there be a discontinuity in the load circuit, the only other possible path for the current from the thyristor, would by through the lamp circuit. In practising the invention, a lamp and limiting resistor are chosen whose current demand is less than the current required to maintain the thyristor in conduction, that is, the hold current or I_H of the thyristor. There is a fairly wide selection of neon lamps available from which one may choose a unit whose rated current requirement is well below the 8 to 10 m.A range of holding currents noted above. Two types which are much in use at present are the NE 51 with a current requirement approximately 0.4 mA and the NE 51H which passes about 2.5 mA of current at 110 V. With a current demand so much lower than the required value for holding currents, the lamp circuit alone is incapable of maintaining the thyristor in the conductive state and the thyristor will not fire, and consequently the lamp will not light either.

In summary then:

In state 1: The load draws current, therefore the thyristor is in conduction, the lamp lights.

In state 2: The load draws no current, therefore, the thyristor is non-conducting, the lamp is out.

In the drawing, Figure 2 shows a very simple circuit for an SCR controller. Refinements of this circuit abound in the literature. Pertinent to this exposition is the placement of the lamp and limiting resistor circuit in parallel with the load. Here, as in the basic circuit of Figure 1, the principal current path is from the a.c. source 1 through switch 2, then through the load 3 and via the SCR 6 back to the other pole of the source. The lamp and its limiting resistor 5 are in series in a sub-circuit which is in parallel with the load. The gate is fed from a point between a variable resistance 8 and a capacitor 9 which are connected in series in another sub-circuit connected in parallel with the SCR.

In the circuit of Figure 2, when gate voltage is sufficient to trigger the SCR into conduction, as it would be when the controller is used to operate an electrical device, the conditions stated in the description of the basic circuit of Figure 1 under the headings of "state 1" and "state 2" prevail.

Figure 3 shows a basic circuit for a Triac controller incorporating the invention. A Triac is an SCR which conducts in both directions. In this Figure too are shown: an a.c. supply 1, one pole of which leads via a switch 2 to a load 3 and thence through a Triac 6 back to the source 1. As in previous Figures, a neon lamp 4 in series with a limiting resistor 5 comprise a sub-circuit which is in parallel with the load. There is another sub-circuit, the gating circuit, connected between main terminal MT2 and main terminal MT1 of the Triac and the gate of the Triac, as follows: from main terminal MT2 through a variable resistor 8 thence through a capacitor 9 to main terminal MT1, the junction between resistor 8 and capacitor 9 being connected to the gate of the Triac via a resistor 11 and the gate of the Triac being connected to the main terminal MT1 via another capacitor 10.

When the Triac controller is put into use in conventional fashion to operate an electrical device, represented by the load 3, the situation is similar to that in which an SCR is used, but with conduction taking place on both halves of the a.c. cycle during normal operation. Here again the relationships which are pertinent to the invention hold, as detailed above in the description of the circuit of Figure 1 under the headings "state 1" and "state 2".

Figure 4 shows a modification of the circuit of Figure 1 which is also applicable to other types of circuit in which the invention is used, by means of which the sensitivity of the current indicator may be adjusted. This figure shows all the circuit elements described in Figure 1, and in addition there is a shunting resistor 12 whose resistance is variable, connected in parallel with the load 3.

The manner in which this operates is as follows: the thyristor requires a minimum holding current, as noted. The current demand of the neon circuit is low. When the load circuit draws enough current so that the load current plus the lamp circuit current totals more than the required holding current, the thyristor will conduct until the a.c. reverses phase. Under normal conditions, where a thyristor is operated at an appreciable percentage of its rated capacity, the sum of these two currents will far exceed the necessary holding current value. It may be that the current indicator is required to show the flow of much smaller currents. In the circuit of Figure 1 for instance, a lamp circuit drawing 2.5 mA together with a thyristor requiring 10 mA could under ideal

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conditions still operate with a load current as low as 7.5 mA.

The addition of the shunting resistor 12 makes it possible to lower the required load current even further by providing an additional current path for the thyristor current. Using the figures in the above example, with a lamp circuit current of 2.5 mA and holding current requirement of 10 mA, an additional flow of say 6.5 mA through the resistor 12, would make the indicator show the flow of current with as little as 1 mA flowing in the load circuit proper.

It may be noted that with the variable resistor 12 adjusted to an extremely high value, the circuits of Figure 1 and Figure 4 become effectively identical.

WHAT I CLAIM IS:—

1. An electrical current flow indicator system for indicating current flow in a.c. powered equipment comprising a thyristor for connection with the anode-cathode path in series between the a.c. power source for the equipment and the equipment, circuitry to trigger the thyristor, when so completed from the a.c. source, and a current indicating device forming at least part of an indicating device circuit for connection in parallel with the equipment, the current indicating device circuit having a current demand substantially lower than the holding current of the thyristor so that in the event that current does not flow in the equipment the holding current of the thyristor will not be maintained and the indicating device will not operate.

2. A system as claimed in claim 1 in which the current indicating device is a lamp.

3. A system as claimed in claim 2 in which the lamp is a neon lamp.

4. A system as claimed in any preceding claim comprising a sensitivity adjustment consisting of a variable resistor connected in parallel with the indicating device circuit.

5. An electrical current flow indicator system for indicating current flow in a.c. powered equipment arranged and adapted to operate substantially as herein described, with reference to and as illustrated in any one of the accompanying drawings.

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1204651 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1.

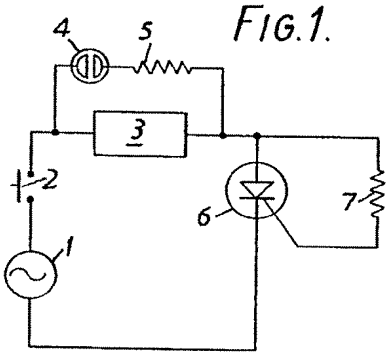


FIG. 2.

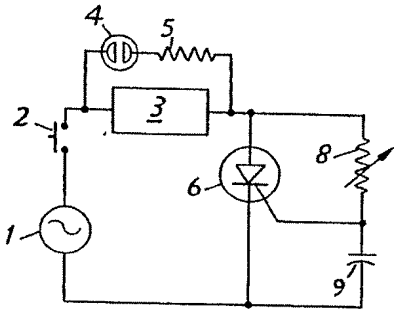


FIG. 3.

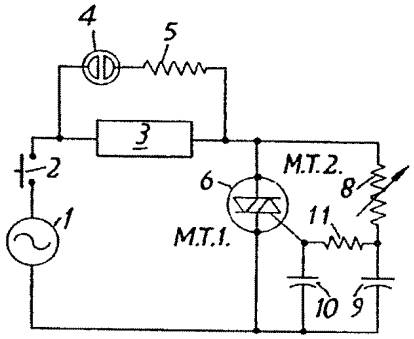
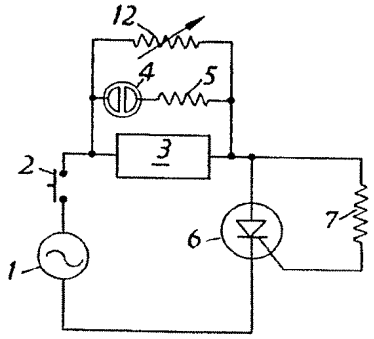


FIG. 4.



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